
Chapter 1

Epidemiology

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The Smokeless Tobacco Problem: Risk Groups in North America

Elbert D. Glover and Penny N. Glover

ABSTRACT Tobacco consumption—most notably smokeless tobacco use—has become one of the fastest growing detrimental health habits in North America. Adolescents still perceive ST as a safe alternative to cigarettes. This paper provides state-specific information about the prevalence of ST use in the United States. A review of the literature reveals that the groups at highest risk are white youth and young adults, aged 10 to 30, with the most vulnerable being those living in the southern United States. It is suggested that further research in several areas is needed for the effectiveness of smokeless tobacco control to be enhanced.

INTRODUCTION Perhaps one of the fastest growing detrimental health habits in North America over the past few years has been the use of smokeless tobacco. There has been an upswing in the popularity of ST among young adults and children. As a result, the topic has captured the attention of the North American press and public as health professionals and legislators seek to alert the populace about health problems associated with the use of smokeless tobacco (Glover et al., 1988).

There are two types of ST—snuff and chewing tobacco. Snuff is a finely ground tobacco of which the user places a pinch (called a dip or rub) in the gingival groove. Snuff can be dry, moist, or in sachets (tea bag-like pouches). The most common position to place snuff is in the mandibular labial mucosa (cuspid to cuspid); however, this is more common in many European countries, especially Sweden. In European countries, sniffing (inhaling) dry snuff through the nostrils is more common than in North America. Chewing tobacco comes in the form of loose leaf, plug, or twist, and the user places a bolus of tobacco (a golf ball-sized piece) inside the cheek. Typically, whenever a user chews tobacco, one will see an extended cheek. This manuscript provides state-specific information regarding the prevalence of ST and reviews the groups at risk for ST use (Christen and Glover, 1987; Christen et al., 1982; Penn, 1902; Smokeless Tobacco Research Council, 1984; USDA, 1969; Vogues, 1984).

HISTORICAL PERSPECTIVE The use of ST in North America appears to have originated with Native Americans. On his trip to the New World, Christopher Columbus discovered Native Americans using tobacco in various forms (e.g., dipping, chewing, rubbing, smoking), and on his return, he introduced tobacco to the Old World. Actually many of his crew were viewed as being possessed by the devil when they expelled smoke from their nostrils; consequently, they were imprisoned (Christen and Glover, 1987; Christen et al., 1982; Penn, 1902). Once Britain established its colonies in North America, the use of ST became deeply entrenched. Before 1900, the dominant form of tobacco used in North America was smokeless tobacco. Three events occurred that began to move North American tobacco users from smokeless tobacco to cigarette smoking: (1) the invention of the cigarette rolling machine, which allowed for mass production of cigarettes; (2) the

postulation of the germ theory, which at the time created a fear that tuberculosis could be spread by spitting tobacco juices; and (3) World War I. Cigarettes were offered and given freely to American combat soldiers, allowing a nation to become hooked on tobacco. Since the turn of the century, smokeless tobacco use declined until the 1970's when, through clever advertising by the tobacco industry, it began to experience a resurgence (Glover et al., 1984; Harper, 1980; Smight, 1981). The annual increase of 10 to 11 percent continued until 1986, when two significant events occurred: (1) a consensus development conference on smokeless tobacco was held in Bethesda, Maryland (Consensus Conference, 1986); and (2) the Surgeon General's first report on smokeless tobacco was published (US DHHS, 1986). These reports helped create a national awareness of ST's effect on health for the first time, along with the much publicized case of Sean Marsee, product labeling, and an advertisement ban. As a result, tobacco sales declined over the next 18 mo (1986 to 1987). Sales and usage bounced back by 1988.

Today, it appears that tobacco use continues to increase, especially among young people. Specifically, moist snuff (e.g., Copenhagen, Skoal), sachets (e.g., Skoal Bandits, Renegades), and loose leaf tobacco (e.g., Red Man, Chattanooga Chew, Levi Garrett) are the smokeless tobacco products that young adults and youth are using (Glover et al., 1988). On the other hand, dry snuff (e.g., Bruton, Dental Snuff), plug (e.g., Bull of the Woods, Red Man Plug), and twist (e.g., Mammoth Cave, Samson) are declining in use. These last products are used primarily by older adults (Glover et al., 1988).

There are an estimated 10 to 12 million ST users in the United States alone (Consensus Conference, 1986; US DHHS, 1986). Youth are using smokeless tobacco products at alarming rates. This resurgence of popularity is attributed to innovative advertising campaigns by tobacco companies. Sports figures promote the product in an attempt to erase the old, unsanitary image of the habit and replace it with a "macho" image (Christen and Glover, 1981; Glover et al., 1981, 1982, and 1988). Because of public pressure, the tobacco companies stopped using current and former sports personalities to promote their products in 1985 (Consensus Conference, 1986; US DHHS, 1986). Today, the tobacco companies focus their advertisements on young white males, using masculine role models in activities such as fishing, hunting, rock climbing, and white-water rafting (Glover et al., 1988). Children tend to model the behavior and accept the values of significant others (e.g., parents, teachers, coaches); consequently, these sport figures are contemporary role models (Glover, 1978).

PREVALENCE The average consumer of ST is in the 18- to 30-yr age bracket, with substantial emphasis by advertisers on the 18- to 20-yr-old group (Maxwell, 1980). However, younger people (as young as 10 to 12) also appear to be influenced by the trend of ST use (Christen, 1980; Hunter et al., 1986; Marty et al., 1986; Schroeder et al., 1987). Some reports indicate that smokeless tobacco is sometimes consumed by individuals younger than age 10 (US DHHS, 1986). A statewide study of 5,392 Texas children in grades 7 through 12 reported that approximately 9 percent were regular ST users (Schaefer et al., 1985). In an Oklahoma statewide study, approximately 13 percent of

third grade males and 22 percent of fifth grade males reported regular use of smokeless tobacco (Glover, 1990). These percentages increased to approximately 22, 33, and 39 percent among the 7th, 9th, and 11th grade males, respectively. In two studies in Oregon, 9 percent of 7th grade males, 19 percent of 9th grade males, and 23 percent of 11th grade males reported using smokeless tobacco daily (Lichtenstein et al., 1985; Severson et al., 1985).

In all the aforementioned studies, females reported a low level of ST use—approximately 1 to 3 percent—which is typical of female use in prevalence studies. However, North American Indians report a much higher use among both males and females (Schinke et al., 1989). Actually, gender is not a predictor of smokeless tobacco use among Native Americans. African Americans and Mexican Americans also report a low rate of smokeless tobacco use. The typical user can be described as a white, rural or suburban, young adult male (Hunter et al., 1980; Marty et al., 1986). These data are not limited to the South and West; northern and eastern states on occasion have reported similar rates of use. However, the use of smokeless tobacco tends to be regional in that some areas report higher rates of use. In Ohio, for example, a survey of adults indicated that 10 percent of the males regularly use some form of snuff or chewing tobacco, with another 5 percent being previous smokeless tobacco users (Schroeder and Chen, 1985). In a Massachusetts study of 5,078 students, 16 percent of the males and 2 percent of the females reported using smokeless tobacco “once or twice” (McCarty and Krakow, 1985). In the only national survey among college students, it was reported that 22 percent of collegiate males are users of smokeless tobacco, whereas 2 percent of females reported using smokeless tobacco (Glover et al., 1986). Although there are no national youth surveys on ST use, a summary of self-reported data on 43,000 students in grades 4 through 11 in 16 locations in the United States and 1 in Canada reported that 40 to 60 percent of males had tried smokeless tobacco and 10 to 20 percent of older males reported recent use (Boyd et al., 1987).

Eight surveys conducted in Canada, Colorado, Georgia, Nebraska, and Oregon indicated that about 8 to 10 percent of the young males (aged 5 to 19) were regular users of smokeless tobacco (Glover et al., 1984). A survey in Pitt County, North Carolina (the county that produces more flue-cured tobacco than any other county in the United States), noted a prevalence of 15 percent (Glover et al., 1987).

As shown in Table 1, recent population surveys estimate the rate of smokeless tobacco use for U.S. males age 16 and older (1985 data) at 5.5 percent and for U.S. males age 18 and older (1987 data) at 6.2 percent (Marcus et al., 1989).

The lowest reported use of smokeless tobacco in the United States was in the Northeast (2.3 percent), and the highest reported use was in the South (8.3 percent) (Marcus et al., 1989). As shown in Tables 2 and 3, West Virginia had the highest prevalence (23.1 percent), and Washington, D.C., showed the lowest (Marcus et al., 1989).

Table 1
Prevalence rates from population surveys

	1985	1987
Snuff	1.9%	3.2%
Chewing Tobacco	3.9	4.1
All ST	5.5	6.2

Source: Marcus et al., 1989.

Table 2
States with the highest prevalence of ST use

State	Prevalence
West Virginia	23.1%
Mississippi	16.5
Wyoming	15.7
Arkansas	14.7
Montana	13.7
Kentucky	13.6
Oklahoma	11.0
Tennessee	10.3
New Mexico	10.2

Table 3
States with the lowest prevalence of ST use

State	Prevalence
Washington, D.C.	0.0%
New Jersey	0.1
Hawaii	0.2
Massachusetts	0.2
Connecticut	0.3
Maryland	0.4
Rhode Island	0.5
New York	0.5
Delaware	0.6

The previous data by Marcus, although reported in an NCI monograph in 1989, were collected in 1985. More recently, patterns of tobacco use were surveyed by the Youth Risk Behavior Surveillance System (Morbidity and Mortality Weekly Report, 1991). This survey used a three-stage sample design to obtain a probability sample of 11,631 students in grades 9 through 12 in 50 states, the District of Columbia, Puerto Rico, and the Virgin Islands. Twenty-two states are noted and reported current use (30 d preceding the survey) at 10 percent. Tables 4 and 5 illustrate the highest and the lowest ST use among states.

GROUPS AT RISK From gleaning the literature, it becomes obvious that the groups at highest risk are white youth and young adults, aged 10 to 30. The tobacco companies aim their advertisements and marketing at these groups (Maxwell, 1980). Moreover, the profile indicates that the southern region is the most vulnerable (Marcus et al., 1989). In addition, smokeless tobacco

Table 4
Highest reported ST use among states in Youth Risk Behavior Surveillance System (1990)

State	Prevalence
West Virginia	20%
South Dakota	19
Oklahoma	16
Kentucky	15
Alabama	14
Nebraska	14
Colorado	13
New Mexico	13
Pennsylvania	13

Table 5
Lowest reported ST use among states in Youth Risk Behavior Surveillance System (1990)

State	Prevalence
Washington, D.C.	1%
Massachusetts	7
New York	7
New Hampshire	8
North Carolina	8
Utah	8
South Carolina	9
Wisconsin	10

use is two to three times more prevalent among blue-collar workers than among white-collar workers.

In our concern for young, white, blue-collar males, it is important that we not ignore females. Virtually all the studies reported ST use by females with only one line and moved on to males' use. At one time we had few female smokers because smoking was neither fashionable nor acceptable. Today, women are smoking at the same rates as men, and it is estimated that there will be more female smokers than male by the year 1996. Today, certain brands of cigarettes are marketed specifically to women; in the future, women may have their own snuff and chewing brands.

Finally, Native Americans (in Canada and the United States, especially Alaska) report disturbing rates of smokeless tobacco use without regard to gender. It appears that Native Americans are in need of education and funds to combat this major health problem.

FURTHER RESEARCH Several areas must be addressed if we are to understand better the health menace of smokeless tobacco.

- There is a need for well-designed studies of the prevalence of ST use based on continuing national and international probability samples. This would allow us to monitor trends.
- These studies should include the following: (1) Identifying the type of tobacco used as moist, dry, or sachet snuff tobacco or loose leaf, plug, or twist chewing tobacco allows us to determine where the problem exists. Because of a lack of knowledge of ST, many researchers lump all products under one category. Yet, in research on smoking tobacco, we know exactly where we stand relative to cigarettes, pipes, and cigars. If data are collected for ST generically, we do not know where the problem exists relative to the type. (2) Age of users. (3) Gender of users. It is critical to recognize women as potential users and collect data on women as well as men. Currently, women do not use ST products in significant numbers. However, if we delay until we have a problem, we then become crisis-oriented. As we collect data, it is critical to collect data on female usage to monitor trends. (4) Region of users. (5) Concomitant cigarette smoking.
- Longitudinal studies are important.
- Operational definitions of users, regular users, heavy users, light users, and ex-users should be set to permit useful comparisons. Only one study has attempted to quantify these terms on the basis of nicotine consumption (Marcus et al., 1989; Schroeder et al., 1988).
- Studies should validate self-reports.
- A national survey for persons aged 12 and under would be beneficial; however, this type of national study is complicated and filled with compliance problems. Moreover, it would be a monumental task to convince an agency to fund such a study.

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Surveillance of and Knowledge About Cancer Associated With Smokeless Tobacco Use

Deborah M. Winn

ABSTRACT Epidemiological studies of smokeless tobacco and cancer continue to show that smokeless tobacco increases oral cancer risk and possibly the risk of other head and neck cancers, suggesting a continuing need to monitor oral cancer trends and to communicate health risks to the public. Cancers of the gum and buccal mucosa, the sites most strongly associated with smokeless tobacco, show no change in incidence since ST use increased in the 1970's; however, it may be premature to expect a rise in oral cancer as a result of smokeless tobacco use. Soft tissue lesions, including oral precancers, are common in ST users. The majority of adult U.S. male users and non-users of smokeless tobacco know that smokeless tobacco use increases the risk of mouth and throat cancer, although older men (age 65 and older) are less informed. A few studies suggest that many adolescents are aware of cancer risks from ST. However, smokeless tobacco use remains high among youth and young men despite their knowledge of health consequences.

INTRODUCTION Epidemiological evidence, as well as studies of carcinogenesis involving the tobacco-specific nitrosamines contained in smokeless tobacco (Hecht and Hoffmann, 1988), have implicated ST as a cause of cancers of the oral cavity and pharynx. The epidemiological evidence is well documented in reviews and evaluations, including the report of an advisory committee to the U.S. Surgeon General (US DHHS, 1986a), the International Agency for Research on Cancer (IARC, 1985), and other documents written up to about 1986 (US DHHS, 1986b), when Federal legislation was passed requiring warning labels on smokeless tobacco products and banning advertising on radio and TV. Since the mid-1980's, work on carcinogenesis has continued, including the development of potential biological markers of exposure to smokeless tobacco (Carmella, 1990).

In addition to the case control and other studies used as the basis for conclusions in the mid-1980's about the carcinogenicity of ST products, several recent epidemiological case control studies of oral cancer (Blot et al., 1988; Spitz et al., 1988; Stockwell and Lyman, 1986), summarized elsewhere (Winn, in press), have examined cancer risks from smokeless tobacco use. All three studies showed that oral cancer risks were elevated among users of smokeless tobacco, with relative risks, the estimate of the ratio of oral and pharyngeal cancer risks in smokeless tobacco users vs. non-users, ranging from 2.3 to 11.2, suggesting moderate to strong associations between ST use and oral cancer sites. However, in one study (Spitz et al., 1988) use of smoking tobacco could not be ruled out as responsible for the association, and the findings had only marginal statistical significance. The other two, both using population-based cancer registries for case ascertainment (ensuring complete enumeration of cases in specific geographic areas), could rule out cigarette smoking and chance as explanations for the findings. In the study that examined numerous head and neck anatomic sites (Stockwell and

Lyman, 1986), ST use was linked to elevated risks in all cancer sites studied, controlling for smoking and other factors; statistically significant excesses were observed for the gum and buccal mucosa, salivary glands, and larynx. In that report, tobacco use histories were obtained through medical record review. Most patients had tobacco use recorded. However, no information was given to determine whether tobacco use data were obtained with equal accuracy in the control group, consisting of patients with other cancers, as for the cases with a head and neck cancer. The third report used interview data for information on tobacco use.

Concern over health effects from smokeless tobacco use has prompted interest in whether oral cancer is becoming epidemic in areas where ST use is common. An additional area of importance to the public health community is the prevention of new smokeless tobacco use and cessation by current users. One aspect of the effort is public education, and public education relies on information about gaps in public knowledge. Both of these issues are examined in greater depth in this report.

TRENDS IN ORAL CANCER INCIDENCE AND MORTALITY Examination of geographic and time trends in cancer incidence and mortality has been useful in identifying or highlighting causes of cancer. For example, the higher mortality rates for malignant melanoma and other skin cancers as latitude decreases (and sun exposure increases) are clearly evident from U.S. maps of cancer mortality based on deaths from 1950 to 1980 (Pickle et al., 1987).

Maps also were important in identifying an epidemic area of oral cancer mortality among women in the southeastern United States (Mason et al., 1975). Interest in this epidemic of high oral cancer mortality among women led to an ecological study (Blot and Fraumeni, 1977) correlating oral cancer mortality with industrial and demographic characteristics and subsequently to a case control study. In that case control study (Winn et al., 1981), it was found that ST use was associated with a fourfold increased risk of oral and pharyngeal cancer. Risks for the gum and buccal mucosa were especially elevated and estimated to increase the risk by close to fiftyfold. Smokeless tobacco was thought to account for 87 percent of the gum and buccal mucosal cancer among women in the epidemic area.

This epidemic is on the downswing as shown by maps of cancer mortality that cover a longer period, for example, from 1950 to 1980, and highlight trends across decades (Mason et al., 1975). These maps show that oral cancer death among women is becoming less common in the southeastern United States and more common in some urban areas elsewhere in the United States. One may infer that the use of snuff, the probable cause of the epidemic in the southeastern United States, is no longer common among women there. U.S. production figures show a decline in demand for dry snuff (US DHHS, 1986a), the type of smokeless tobacco most commonly used by the women in the study.

Incidence as well as mortality data are available for examination of time trends. According to data from the Surveillance, Epidemiology, and End Results (SEER) program from 1947 to 1984 (Devesa et al., 1987), the incidence of oral cancer among women increased by more than 50 percent

during the four decades to 5.3/100,000 women. Although the incidence rate during this interval remained fairly constant for men across all ages, at about 12.3 to 13.5/100,000 men, this stability obscures an increase in incidence among younger cohorts and a decrease among older cohorts. Devesa and coworkers (1987) suggest that adoption of cigarette smoking among women might account for the rise in incidence of oral cancer. They also suggest that the decrease in older men was consistent with gradual declines in ST use and pipe smoking during the century, and that cigarettes and, possibly, alcohol might account for increases among the younger age groups.

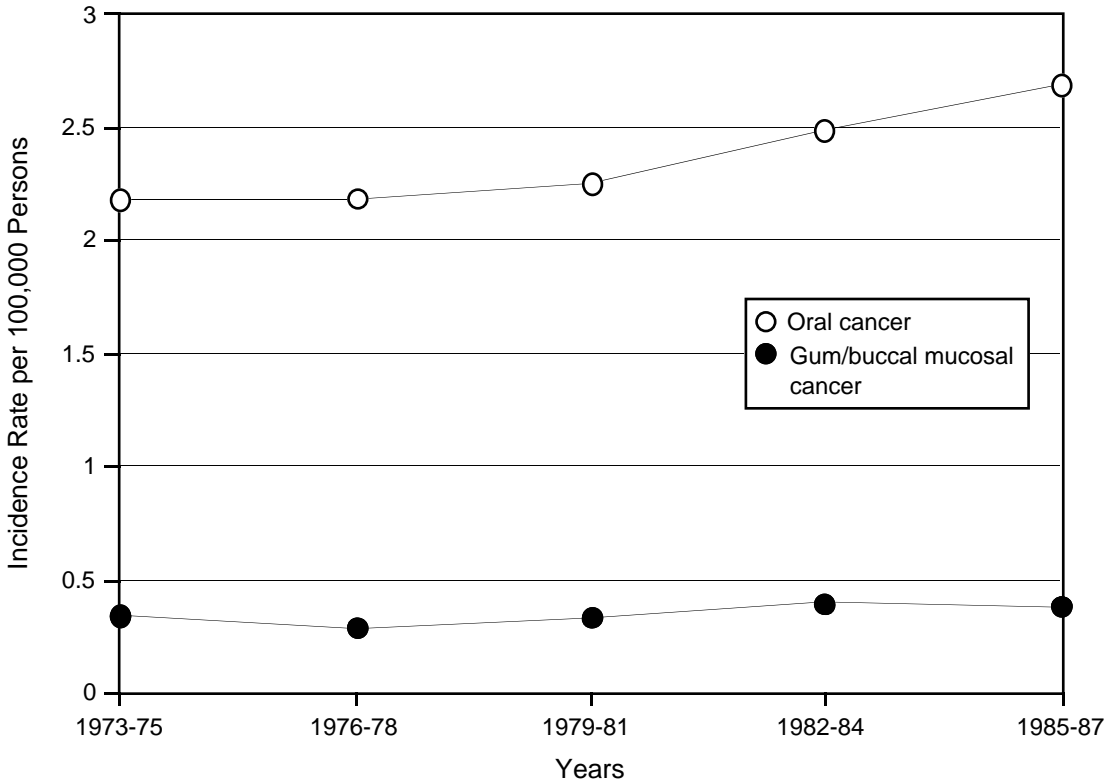
It is difficult to correlate tobacco use patterns with oral cancer incidence and mortality because of the relatively sparse data on tobacco use patterns from small geographic units such as counties. Also, the long latency for cancers makes it difficult to know when to expect a change in incidence after a population changes its risk-factor habits. Nevertheless, available cancer surveillance data have been examined for changes in cancer occurrence.

Partly inspired by concern over potential rises in oral cancer associated with ST use by youth, several letters to the editors of medical journals were published presenting data on tongue cancer from cancer hospital records and from U.S. incidence and mortality data bases (Davis and Severson, 1987; Depue, 1986; Schantz et al., 1984; Shemen, 1984). In all of these reports, tongue cancer rose when measured by increases in incidence or mortality or as a proportion of cancers seen at cancer centers. However, it has not been possible to elucidate the causes of this increase.

If smokeless tobacco use among young men is leading to an epidemic of oral cancer, then it might be expected that a rise in incidence might be detected or be clearly evident for cancers of the gum and buccal mucosa because of the strong relative risks associated with ST and this cancer site. Figure 1 shows the incidence of oral cancer and the incidence of gum and buccal mucosal cancer (a subset of all oral cancers) from 1973 to 1987 among men under age 50 from the SEER program, which includes data from population-based cancer registries covering about 10 percent of the U.S. population. Gum and buccal mucosal cancer incidence essentially was unchanged during this 15-yr period, in spite of a corresponding rise in ST use, although oral cancer in general has been increasing among younger men. Although there was no increase in the incidence of gum and buccal mucosal cancer during this period, it should be noted that baseline rates of these cancers are very low in younger adults (< 0.5/100,000 new cancers per year in men under age 50); oral cancer typically occurs at older ages (62.4 is the median age of diagnosis [Young et al., 1981]); and case control studies suggest that most individuals with oral cancer associated with ST use have used the products for a long time. This would suggest that it may be too early to detect any cancer consequences of increased ST use.

Oral mucosal lesions are common in ST users. In surveys of adolescents, lesions ranging from small local mucosal changes involving slight color and texture modifications to more significant color changes and deep

Figure 1

Incidence of oral cancer: males under age 50, 1973 to 1987

Source: SEER Program, 1973 to 1987.

furrowing have been observed in between 23 and 63 percent of smokeless tobacco users (Centers for Disease Control, 1988; Greer and Poulson, 1983; Offenbacher and Weathers, 1985; Poulson et al., 1984), far exceeding those among non-users (Offenbacher and Weathers, 1985). The more serious lesion, leukoplakia, has been noted in small proportions of young users. In one study, leukoplakia was observed in 5.0 percent of high school football players in Alabama, in contrast to only 0.1 percent among non-users (Creath et al., 1988). Leukoplakia had a prevalence of 46.0 percent among ST-using professional baseball players, whereas only 1.4 percent of non-users had leukoplakia (Ernster et al., 1990).

The transformation of leukoplakia to frank carcinoma is a concern. In one study in India (Gupta et al., 1980), malignant transformation of leukoplakia occurred at a rate of 0.9/1,000 among persons ages 35 to 54 and 10.2/1,000/yr among older persons. The authors summarized the literature on transformation rates, which suggests that between 0.13 and 10.0 percent of leukoplakias will transform, but the studies involved differing followup periods and lesion definitions.

Few other recent studies on this subject have been conducted. There are variations in the risk of transformation to cancer by type of leukoplakia (Gupta et al., 1989), and precise estimates of transformation rates for non-Asian populations are lacking. Some information on the prevalence of oral soft tissue lesions from 1957 to 1973 is available, based on data from large oral cancer screening clinics, some of which covered more than half of the target communities (Bouquot and Gorlin, 1986). However, currently in the United States, leukoplakia (or other precancerous lesions) is not reportable to population-based cancer or other registries, so statistical data on prevalence, incidence, and trends over time for leukoplakia are not obtainable. National prevalence estimates for leukoplakia and ST-associated lesions will be available on the completion of the Third National Health and Nutrition Examination Survey conducted by the Centers for Disease Control's National Center for Health Statistics.

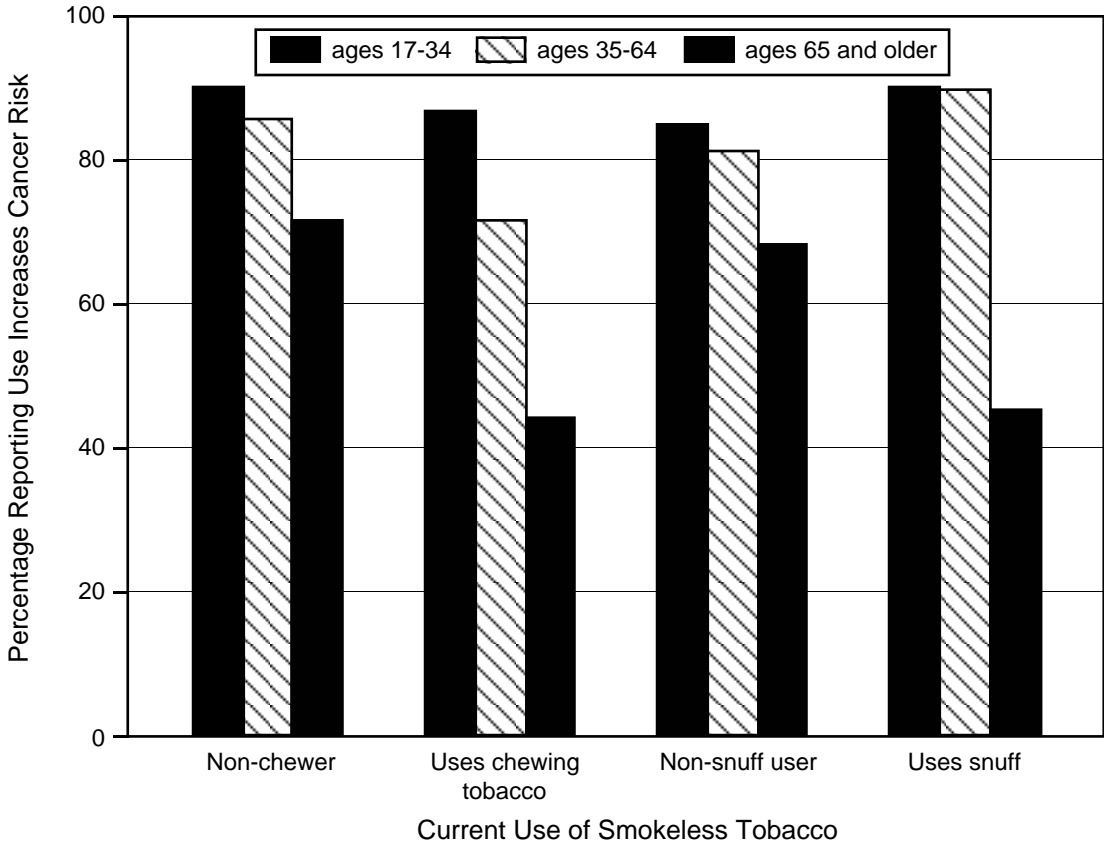
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OF ST AND
CANCER LINKS**

About 6 percent of U.S. adult men use smokeless tobacco, according to data from the National Health Interview Survey (NHIS) of Cancer Epidemiology and Control conducted in 1987 by the National Center for Health Statistics; the survey indicated that smokeless tobacco use by women overall was negligible (0.5 percent) (Schoenborn and Boyd, 1989). The NHIS is a continuous, multipurpose, cross-sectional survey used to obtain national estimates of health characteristics through household interviews. The survey has a multistage, probability, cluster sample design. In the 1987 NHIS, members of the U.S. public were asked questions about whether they thought that snuff and chewing tobacco increase the risk of mouth and throat cancer. The percentages of U.S. men reporting that these products increase cancer risks were similar for snuff (79.9 percent) and for chewing tobacco (83.8 percent). Among tobacco chewers, 71.5 percent thought that their habit increases risk, compared to 85.1 percent among non-users of chewing tobacco. The corresponding figures concerning risks due to snuff use were 85.1 percent and 80.6 percent for snuff users and non-users, respectively. Figure 2 shows that knowledge was inversely related to age, with more younger men being informed; 80 percent or more of those under age 65 knew of mouth and throat cancer risks, compared to about 70 percent of older men.

The NHIS survey covered adults only, but several regional studies, generally conducted in areas where ST use among youth is common, suggest that two-thirds or more of adolescents understand that ST use can cause cancer. Missouri users in grades 5, 8, and 12 were similar to non-users in knowing that smokeless tobacco causes mouth cancer (75 and 80 percent, respectively) (Brownson et al., 1990); furthermore, knowledge of health risks improved with age. A Texas survey (Schaefer et al., 1985) showed that 67 percent of high school students surveyed thought that snuff and chewing tobacco cause cancer. In another study, in Alabama (Creath et al., 1988), 93.7 percent of male high school football players and 92.5 percent of those who used ST were aware that using smokeless tobacco could be harmful to health; "cancer" was the most common response to a question about how health was affected by these products. These data suggest a fairly high level

Figure 2

Males who report that smokeless tobacco increases cancer risk, United States, 1987



Source: NCHS, NHIS, 1987.

of knowledge among all ages that smokeless tobacco causes cancer. However, the relation of health knowledge to behavior is uncertain; it seems clear that knowledge alone is insufficient to reduce significant ST use in these populations.

RESEARCH NEEDS This report suggests some important research needs:

- Longitudinal studies of persons with ST-associated oral lesions are needed to examine the natural history of these lesions, including their continuance, regression, and progression. Factors influencing the natural history of the lesions must be determined.
- Definitions and classifications of oral lesions vary in studies involving mucosal examinations and should be standardized, possibly through an international consensus conference. The same definitions should be used by all investigators to allow comparison of results across studies.

- Cancer incidence and mortality surveillance systems should continue to monitor oral cancer trends in view of the increasing numbers of smokeless tobacco users and the potential for rises in oral cancer incidence rates.
- Better data are needed on the transformation rates for leukoplakia in U.S. populations.
- Finally, more data are needed on how knowledge of health risks and health education can be used to prevent ST use and encourage effective cessation efforts.

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Smokeless Tobacco Use in India¹

P.C. Gupta

ABSTRACT Smokeless tobacco use is very common in India and neighboring countries. The betel quid chewing habit and its variants predominate, but several other forms of ST also are popular. The major use of ST is in the form of custom-made preparations from individual ingredients for immediate use. In recent years several commercial ST products have been marketed, with backing by intense advertising and promotion campaigns. It has been possible to educate rural Indian populations and thereby persuade them to reduce their tobacco use; such education has significantly decreased the risk of oral cancer.

INTRODUCTION Smokeless tobacco use may be of two kinds: oral use and nasal use. In India and Southeast Asia, nasal use is uncommon; therefore, only oral use is described in this paper.

In India, the neighboring countries, and some other countries of the southeast region, smokeless tobacco use is very common, although it has declined over time. Trend data on the prevalence of ST use are not available, but inferences may be drawn from the data on total tobacco consumption. Analysis of the per capita amount of tobacco consumed in both smoked and smokeless tobacco forms in India over the past 40 years has shown that smoking has increased considerably, but smokeless tobacco has declined from its position as the dominant form (Sanghvi, 1989).

Reliable prevalence data from some selected parts of India became available during the late 1960's and early 1970's, when large cross-sectional, house-to-house surveys of tobacco habits were conducted in rural populations (Mehta et al., 1969 and 1972). Table 1 shows the sample size and the prevalence of overall tobacco use (smoking and chewing), by sex, among individuals aged 15 and over. It is clear that tobacco use is very common in India. Among men it is uniformly high, but among women there is great variability. The areas surveyed were selected with specific objectives and thus may not represent the whole of India. They are, however, widely dispersed areas and do represent a large part of the country.

Table 2 shows the prevalence of smokeless tobacco use among non-smokers and smokers, and the overall prevalence of use. The prevalence of ST use varied markedly in different regions, although in general it was comparable between smokers and nonsmokers. In most places, ST use was found to be more common among women.

A high prevalence of smokeless tobacco use in India may be somewhat surprising because tobacco was introduced in India, like everywhere else, by the Europeans about 400 years ago, primarily as a substance for smoking. To learn the reasons for the popularity of ST use, one has to look at some ancient cultural practices of this region.

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Table 1

Prevalence of tobacco use (smoking and smokeless) in India, from population-based, house-to-house studies

Area	Sample Size	Tobacco Users, Percentage		
		Men	Women	All Over Age 15
Bhavnagar	10,071	71%	15%	44%
Ernakulam	10,287	81	39	59
Strikakulam	10,169	81	33	56
Singhbhum	10,048	81	33	56
Darabhanga	10,340	78	51	64
Pune	101,761	62	49	64

TYPES OF ST USED

The most common methods of ST use in India are betel quid chewing and its variants. Betel quid chewing is an ancient practice—several millennia old. Betel quid is mentioned in ancient religious texts, medicinal treatises, literary works, and old stone inscriptions. It has always been a part of religious, social, and cultural rituals, and the practice enjoys complete social acceptance, even today.

Traditionally betel quid consisted of betel leaf, pieces of areca nut, a few drops of lime (calcium hydroxide), several condiments, sweetening, and flavoring agents, depending on regional practices and individual preferences. After tobacco was introduced in India in the 17th century, it became an ingredient of the betel quid. Through its association with a socially accepted practice, ST use became widespread. Currently almost all habitual users of betel quid use it with tobacco. The habit is widespread in all parts of India and is practiced by both men and women.

Until recently, the habit of betel quid chewing was not recognized as an ST habit. In the literature, betel quid chewing was generally referred to as “betel nut” chewing. This terminology was probably responsible for the erroneous impression that the nut used in the betel quid was the main active substance for carcinogenesis. The term “betel nut” is a misnomer, because the nut used in the betel quid is from the palm *Areca catachu* and therefore should be called “areca nut” (Burton-Bradly, 1979).

The betel quid chewing habit evolved into several variants such as chewing of *mawa*, *khaini*, *mainpuri* tobacco, and, more recently, various brands of commercially manufactured and marketed *pan masala*. Probably a major reason for the popularity of these variants is the perishability of the betel leaf, a fresh green leaf from the betel vine, in which various ingredients of the quid are smeared and wrapped. The tenderness and freshness of the leaf are highly prized, and therefore betel leaf does not last for more than a few days. Betel vine is said to be a delicate plant, requiring much care and attention, and cannot be grown everywhere. The leaf is thus difficult to obtain in places distant from betel-growing areas.

Table 2
ST use among men and women, smokers and nonsmokers

Area	Men, Percentage			Women, Percentage		
	Smokers	Nonsmokers	Overall	Smokers	Nonsmokers	Overall
Gujurat	10%	24%	15%	0%	15%	15%
Kerala	33	42	36	43	38	38
Srikakulam	16	16	16	4	8	6
Darabhanga	52	56	54	8	12	11
Singhbhum	22	47	31	25	28	27
Maharashtra	30	58	56	0	49	49

Although the betel quid itself, as well as various combinations of its ingredients, can be chewed with or without the inclusion of tobacco, most habitual chewers include tobacco in their quid. This is understandable because tobacco is the only addictive substance among the betel quid ingredients. This point was not recognized, however, until evidence emerged from house-to-house, cross-sectional studies of large samples of rural populations (Mehta et al., 1969 and 1972).

Table 3 shows the prevalence of chewing habits in some areas where chewing was reported to be popular. The table shows the prevalence of chewing among nonsmokers, the proportion of chewers who exclude tobacco from their quid, and those who include tobacco. Smokers are excluded from the table. The data readily confirm that, although chewing habits were popular, the proportion of those who excluded tobacco from their quid was minuscule. In different areas, different kinds of chewing habits prevailed; for example, the predominant chewing substance in Ernakulam district was betel quid, whereas in Pune district it was tobacco and lime.

The tobacco-plus-lime mixture is probably the most common variant of the betel quid. The mixture is known as *khaini* in the northern part of India, and it is popular in other parts as well. Tobacco-plus-lime is the most common form of tobacco used in Pune district.

A user typically carries a double-mouth box, the larger part containing tobacco flakes and the smaller one lime (calcium hydroxide) paste. To prepare the quid, the user places a small amount of tobacco in the palm; a dash of lime is flicked by a thumb or forefinger, and it is mixed and rubbed vigorously with the tobacco in the hand. The mixture is then ready for use and is placed in the mouth. Some individuals may add pieces of areca nut as well.

The exact placement of the tobacco-plus-lime mixture in the mouth varies by geographic area. In Pune district, the mixture is often placed in the canine region; in Darabhanga, in the labial groove; and in Singhbhum district, many users prefer to keep it on the tongue. The most common sites of oral cancers and precancers also vary correspondingly in those regions.

Table 3

Comparison of individuals who use tobacco in their chewing quid with those who do not

	In Ernakulam (n=10,287)	In Singhbhum (n=10,048)	In Maharashtra (n=101,761)
Number of Chewers ^a	2,699	1,334	51,835
With tobacco	99%	97%	99%
Without tobacco	1%	3%	1%

^a Without any smoking habit.

Mawa is another variant of betel quid that contains areca nut, tobacco, and lime. *Mawa* is popular in Bhavnagar district and nearby areas, but in other areas it may be known by different names. By weight, more than 90 percent of *mawa* is areca nut. It is prepared immediately prior to use and is generally purchased from kiosks that sell betel quid and other tobacco products. The vendor places small pieces of sun-cured areca nut (5.5 g) on a piece of cellophane (10 to 13 cm), adds tobacco flakes (0.4 g), and sprinkles a few drops of a solution of calcium hydroxide. The mixture is then tied as a round ball in the cellophane wrapper and given to the customer. A user typically rubs the cellophane ball vigorously on the palm for a couple of minutes, ostensibly to homogenize the *mawa* mixture. (More likely, this action produces greater availability of free nicotine through the action of calcium hydroxide on tobacco.) The user then opens the cellophane, removes any veins of tobacco leaf, and puts the mixture into the mouth. One quid may be chewed for 10 to 20 min. Some users may chew only half of the quid at one time (Sinor et al., 1990).

The most recent variant on betel quid is *pan masala*, a manufactured item containing areca nut and other ingredients common in betel quid; some brands contain dehydrated and powdered betel leaves. *Pan masala* is generally available in two types—with tobacco and without tobacco—sold under the same brand name. The single name for both choices affords a significant marketing advantage to the manufacturer. Since there are no restrictions on advertising a consumer product that contains no tobacco, *pan masala* without tobacco is vigorously advertised and promoted, without restriction, even on the government-controlled electronic media. *Pan masala* with tobacco, however, carries the same brand name and therefore gets considerable benefit from the unrestricted advertisement and promotion of the nontobacco counterpart.

The vigorous, high-profile advertising of *pan masala* has prompted manufacturers who rarely advertised their chewing products before to start advertising heavily as well. As a result, advertisements of commercially manufactured and marketed ST products are common on the roads, in magazines, and in videotapes. It is easy to discern the target group: urban individuals with education, traditional values, and disposable income. Recently, working women and middle-class housewives also seem to have become a specific target of such advertisements.

New and more effective ways of advertising and promoting are constantly explored and employed. For example, in the videocassette versions of Indian films, animation is used to superimpose dancing tobacco products on the movie so that viewers cannot avoid the commercial. The March 1991 issue of several magazines contained not only an advertisement of a particular brand of chewing tobacco, but also, for the first time, a free product sample pasted on the advertisement.

As a result of such high-profile advertising, ST use is increasing rapidly in the stratum of society from which it had almost disappeared—among individuals with college education who are in business and in middle and high-level management positions. No hard data are yet available, but cans and sachets of smokeless tobacco are becoming more common in public places where well-educated people are seen, for example, in airport lounges. Medical practitioners are reporting a rapid increase in the incidence of oral submucous fibrosis, a chronic debilitating disease with no known cure, believed to be caused by areca-nut chewing (Bhonsle et al., 1987; Sinor et al., 1990).

There are also several methods of ST use that cannot be termed variants of betel quid chewing. One of them is use of manufactured snuff, which is common in the Western Region. Dry snuff is meant for nasal use, but oral use is more common in India. There is a difference in variety as well; finer snuff is for nasal use and coarser snuff for oral use. Manufacturers market snuff as *tapkeer*, but local names may differ. One method of using dry snuff is oral application with a dry twig, identical to the snuff dipping described among women in North Carolina (Winn et al., 1981).

Mishri is a powdered form of roasted tobacco. It is common in Maharashtra and central regions of India, especially among women. People begin using *mishri* as a dentifrice, but it soon turns into an addiction. A typical user applies *mishri* to the teeth and gums several times a day.

Tobacco is also used in the form of *gudakhu*, a paste made of tobacco and molasses. This is common in the eastern region. Creamy snuff, common in Goa, is a manufactured item marketed in toothpaste-like tubes. Its marketing technique exploits the prevailing misconception that tobacco is good for the teeth and gums. There are several herbal and medicinal tooth powders that contain tobacco.

EFFECTS OF ST USE The most extensively studied and best documented health consequence of ST use in India is oral cancer. Numerous case-control and some cohort studies have clearly demonstrated the causal role of smokeless tobacco in oral cancer. This subject has already been reviewed and evaluated in depth (IARC, 1984). Interestingly, the experimental as well as epidemiological evidence with respect to areca nut chewing has been assessed as inadequate to demonstrate carcinogenicity (Gupta et al., 1982; IARC, 1984).

A less studied health consequence is the effect of smokeless tobacco use on reproduction. Two studies have indicated that ST use during pregnancy leads to significantly lower birth weight, higher placenta weight, and higher infant mortality (Krishnamurty, 1989).

Overall health consequences of smokeless tobacco use in India have been assessed through examination of the relative risk of all-cause mortality among tobacco users. This was done through cohort studies in two areas. In one area where *bidi* smoking and betel quid chewing were prevalent, the age-adjusted excess risk among smokers was 40 percent ($p < 0.05$). Surprisingly, even among chewers who did not smoke, the excess risk was 30 percent ($p < 0.05$). There was no clue, however, as to specific causes of this excess mortality among chewers (except oral cancer) because of a lack of information on the causes of death (Gupta et al., 1984a).

In another area, where reverse smoking was practiced, the age-adjusted excess mortality was close to 100 percent (Gupta et al., 1984b). An attempt has been made to estimate excess mortality attributable to tobacco use. The estimate is that every year, 630,000 adult deaths occur prematurely because of tobacco use in India (Gupta, 1988). Because of insufficient information, it is possible to categorize only 56 percent of these excess deaths according to cause (Notani et al., 1989).

EFFECTS OF EDUCATION Can the tobacco habits in rural populations be changed through educational efforts, and would such efforts result in any health benefit?

An answer to this question has been provided by an intervention study among rural Indian populations in three areas of India. More than 36,000 tobacco users were interviewed about tobacco use and examined for the presence of oral cancer and precancerous lesions. All these individuals were educated about the health hazards of tobacco use. Personal communication was provided by the examining dentist and a social scientist. Subjects also were educated through the use of documentary films, posters, newspaper articles, radio messages, and folk-art theater.

Considerable social science research was carried out to assess why people begin using tobacco, why they continue using it, what they perceive as the health effects of using tobacco, and what influences could help them discontinue its use. This research was continuous, and feedback was incorporated into the education program. The educational campaign was also continuous; interviews and examinations were carried out yearly. An assessment after 5 yr of followup showed that a significantly higher percentage of people in the intervention cohort stopped or reduced their tobacco use (smoking as well as ST use) than in the control cohort. Consequently, the incidence of precancerous lesions decreased substantially in the intervention cohort compared to the control cohort. Higher quit rates were achieved among smokeless tobacco users and thus the reduction in risk was also greater (Gupta et al., 1986a and 1986b). Similar results were reported after 8 yr of followup (Gupta et al., 1989).

CONCLUSION On the whole, this discussion shows that the problem of smokeless tobacco use in India is quite different from that in industrialized countries. The health consequences of ST use are very serious but, except for oral cancer, are not as well understood as the consequences of cigarette smoking. It is possible to educate the population about the health risks of smokeless tobacco. Such an effort would result in a significant health benefit to the population.

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Smokeless Tobacco in Professional Baseball: Patterns of Players' Use¹

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ABSTRACT Smokeless tobacco use was examined in 2,009 professional baseball players as part of a study of oral and other health effects of ST use conducted at spring training in 1988, 1989, and 1990. According to questionnaire data, 37.5 percent of participants had used ST within the previous week. Among current-week users, the median age at first ST use was 17 yr, median duration of use was 5 yr, median amount of use per day was 1 h, and median cotinine level was 92.8 ng/mL. The reported ST product usually used was more often a snuff than a chewing tobacco brand (77.1 vs. 19.7 percent, respectively). Of current-week users, 49 percent were year-round users. The latter used ST more hours per day, had used ST more recently, were more likely to use snuff, and had higher serum cotinine levels than did seasonal users. Similar differences were seen in comparisons of snuff to chewing tobacco users. Most ST users considered ST harmful to health; however, snuff users were more likely to report ST as "very" harmful, and year-round snuff users most likely to have noticed oral effects of use. Snuff users appeared more motivated to quit than did chewing tobacco users.

INTRODUCTION Over the 3-yr period from 1988 through 1990, we collected data on smokeless tobacco use among professional baseball players as part of a study of oral and other health effects of ST use. A description of the overall study design and highlights of the findings from the first year of the study have been published elsewhere (Ernster et al., 1990). Here we provide a detailed description of ST use patterns in professional baseball players, based on the combined data from all 3 yr of the study.

METHODS During spring training of 1988, 1989, and 1990, all players and coaching staff of the seven Major League Baseball teams and their associated minor league teams that conduct spring training in Phoenix and Tucson, Arizona, were eligible to participate in the study. Participants completed a questionnaire that provided detailed information about their patterns of ST use, as well as demographic and other data. In all 3 yr of the study, information was collected on age at initiation of ST use, duration of use, amount used, and type and brand of ST used most often. Analyses of type (snuff or chewing tobacco), brand, and amount (cans of snuff or pouches of chewing tobacco used per week) were based on the reported type usually used. Because some participants who usually used one type of ST (snuff or chew) also used the other type, we also calculated the number of hours of ST use per day as a combined measure of amount of use. Information about differences in ST use during the baseball season compared with the off-season were collected only in years 2 and 3 of the study, and data on perceptions of health effects and attempts to quit using ST were collected only in year 2. A question about perceived readiness to quit using ST was added in year 3.

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On the basis of their self-reported ST use, we classified participants as non-users (those who had never used ST or who had never used it more than once a month in the past), former users (those who had used ST more than once a month in the past but not within the previous month), and current users (those who had used ST more than once per month and had used it within the previous month). Current users were further divided into current-month users (those who had used ST within the past month but not within the past week) and current-week users (those who had used ST within the past week). Unless otherwise indicated, the results reported here for current ST users pertain only to current-week users.

During the first 2 yr of the study, blood was drawn for biochemical validation of self-reported ST use. Low serum cotinine levels (< 12 ng/mL) together with normal serum thiocyanate levels (< 85 mmol/L) were considered biochemical evidence of no use of tobacco. According to this standard, 95 percent of participants in the first year of the study from whom blood samples were available and who reported that they neither used ST nor smoked cigarettes (357 of 376) were classified biochemically as non-users. Given the accuracy of self-reported use status and because blood was collected from only about 80 percent of players in the first year of the study, 50 percent of players in the second year, and none of the players in the third year, ST use status in this paper is based on self-report. Data on cotinine levels are for those players from whom blood was obtained in the first 2 yr of the study. Finally, information on most recent ST use was collected only in the first 2 yr of the study.

For univariate statistical analyses, standard t tests and χ^2 tests were performed, as appropriate. We have based the p values for the multivariate analyses on the standard errors of log odds ratios, adjusted for covariates by means of multiple logistic analysis (Hosner and Lemeshow, 1989).

RESULTS The distribution of the participants by age, race, education, cigarette smoking, and alcohol use at the time of entry into the study is shown in Table 1. These are the combined baseline data from players who were new to the study in each of the 3 yr, a total of 2,039 players (1,109 first seen in 1988, 532 first seen in 1989, and 398 first seen in 1990). A majority of the players were aged 20 to 29 yr (76.3 percent), were white (68.1 percent), and had had at least some college education (75.2 percent). Current cigarette smoking was rare (3.1 percent), and alcohol consumption was generally moderate (21.3 percent were nondrinkers and 72.5 percent consumed fewer than 14 drinks per week).

At baseline, 37.5 percent of participants reported having used ST within the past week and 3.4 percent within the past month but not the past week; 12.6 percent reported themselves to be former ST users and 46.5 percent non-users (Figure 1). We deleted from the analysis 30 players for whom ST use status was not determined. Characteristics of ST use among current-week users, again based on the combined baseline data, are shown in Table 2. The median age at first use of ST was 17 yr, median duration of use was 5 yr, and median time ST was used per day was 1 h. With respect to brand usually used, 77.1 percent of players named a snuff brand and only

Table 1
Baseline demographic and other characteristics from all 3 yr combined

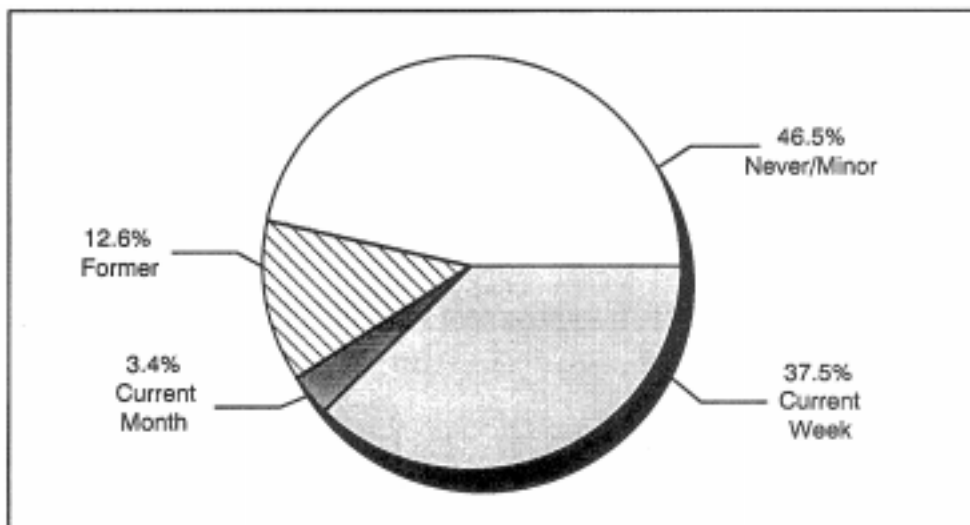
	Number ^a	Percentage ^b
Age		
< 20 yr	241	11.9%
20 to 24	1,125	55.6
25 to 29	419	20.7
30 to 34	129	6.4
35 to 39	48	2.4
≥ 40	63	3.1
Total	2,025	100.1
Race		
White	1,387	68.1
Hispanic	350	17.2
Black	269	13.2
Asian	25	1.2
Other	5	0.2
Total	2,036	99.9
Education		
Elementary	43	2.2
Some high school	76	3.8
High school graduate	375	18.8
Some college	1,041	52.3
College graduate	455	22.9
Total	1,990	100.0
Cigarette Smoking		
Never-smoker	1,779	88.1
Former smoker	177	8.8
Current smoker	63	3.1
Total	2,019	100.0
Alcohol Consumption		
Nondrinker	429	21.3
< 14 drinks per week	1,459	72.5
14 to 20 drinks per week	85	4.2
> 20 drinks per week	40	2.0
Total	2,013	100.0

^a Totals vary because of missing data.

^b Totals vary from 100 percent because of rounding.

19.7 percent a brand of chewing tobacco; 3.1 percent listed both. Among those who usually used snuff, Copenhagen and Skoal (69.5 percent and 20.8 percent, respectively) were the most popular brands named, and among those who usually used chew, Levi Garrett and Red Man (46.9 percent and 40.7 percent, respectively) were the most popular. Among snuff users, 39.7 percent used less than one can per week, 35.8 percent used one to three

Figure 1
Distribution of subjects (n=2,009) at baseline examination, by ST use



cans per week, and 24.4 percent used more than three cans per week (median = two cans per week). Among chewing tobacco users 48.9 percent used less than one pouch per week, 31.1 percent used one to three pouches per week, and 20.0 percent used more than three pouches per week (median = 1.5 pouches per week). Data on most recent ST use and cotinine levels were available for participants who entered the study in 1988 or 1989. Among current-week users, nearly one-third (30.7 percent) reported using ST within the preceding hour (median = 3.8 h since last use), and 76.1 percent had serum cotinine levels 25 ng/mL (median = 92.8 ng/mL).

Because data on seasonal use were collected only in years 2 and 3 of the study, analyses of characteristics associated with seasonal vs. year-round use are confined to all current ST users seen in year 2 of the study, whether or not they had been in the study in year 1 (n=397), plus all current users new to the study in year 3 (n=160). These data showed that about one-half of current-week users (51 percent) used ST almost exclusively during the baseball season (“I rarely use it during off-season”).

Given the accepted addictiveness of tobacco use, it was curious to us that fully half of the current-week users were able to refrain from ST during the off-season. We therefore decided to compare characteristics of seasonal and year-round ST users in our study (Table 3). There were no significant differences in age or race, but year-round users were significantly more likely to have started using ST at an early age (mean age at initiation of use was 16.2 vs. 17.4 yr for year-round and seasonal users, respectively), to have used ST for a longer period of time (7.0 vs. 5.1 yr), to currently use ST more hours per day (2.1 vs. 0.9 h), to have used ST more recently (10.5 vs. 25.8 h since last use), to use snuff (90.0 percent vs. 66.4 percent), and to be white (87.4 vs. 77.0 percent).

Table 2
ST use characteristics in current-week users^a

	Number ^b	Percentage ^c
Age at First Use		
< 10 yr	18	2.4%
10 to 14	141	18.7
15 to 19	444	59.0
≥ 20	150	19.9
Total	753	100.0
Duration of Use		
≤ 3 yr	206	27.9
4 to 6	275	37.2
7 to 9	119	16.1
≥ 10	139	18.8
Total	739	100.0
Hours in Mouth		
0.0 to 0.5 h/d	186	27.2
> 0.5 to 1.0	157	23.0
> 1.0 to 1.5	93	13.6
> 1.5 to 2.0	67	9.8
> 2.0 to 4.0	123	18.0
≥ 4.0	57	8.3
Total	683	99.9
Type of ST Usually Used		
Snuff	567	77.1
Chew	145	19.7
Both equally	23	3.1
Total	735	99.9
Brand of Snuff Usually Used		
Copenhagen	394	69.5
Skoal	118	20.8
Hawken	37	6.5
Other	18	3.2
Total	567	100.0
Brand of Chew Usually Used		
Levi Garrett	68	46.9
Red Man	59	40.7
Other	18	12.4
Total	145	100.0
Amount of Use		
Snuff (cans/wk) ^d		
≤ 1	216	39.7
> 1 to 3	195	35.8
> 3	133	24.4
Total	544	99.9

Footnotes at end of table.

Table 2 (continued)

	Number ^b	Percentage ^c
Amount of Use (continued)		
Chew (pouches/wk) ^e		
≤ 1	66	48.9%
> 1 to 3	42	31.1
> 3	27	20.0
Total	135	100.0
Time Since Last Use ^f		
> 24 h	86	15.9
> 12 to 24	134	24.8
> 1 to 12	155	28.6
≤ 1	166	30.7
Total	541	100.0
Cotinine (ng/mL) ^f		
0 to 25	99	23.9
> 25 to 75	87	21.0
> 75 to 200	133	32.0
> 200	96	23.1
Total	415	100.0

^a Includes baseline data for current-week users from all 3 yr combined for all variables except cotinine, most recent use, and seasonal use.

^b Totals vary because of missing data.

^c Totals vary from 100 percent because of rounding.

^d Includes only subjects who usually use snuff.

^e Includes only subjects who usually use chew.

^f Includes all current-week users seen in year 1 plus all new current-week players from year 2.

We then attempted to determine which of these ST use variables were independently associated with seasonal use by constructing a multiple logistic regression model with seasonal use as the dependent variable and age, race, age at first use, amount, type, duration, and most recent use as the predictor variables. This analysis was confined to year 2 users, the only group with data on both seasonal use and most recent use. Only hours of use per day ($p < 0.0001$) and type of ST usually used ($p=0.0008$) were independently associated with seasonal use in the multivariate model. Duration of use may also be independently associated with seasonal use ($p=0.066$). Analyses of brand and amount used in relation to seasonality of use were performed separately for snuff and for chewing tobacco users (Table 4). Among year-round snuff users, Copenhagen was more commonly used and Hawken less commonly used than among seasonal snuff users; and year-round users were much more likely than seasonal users to report use of more than three cans per week. There were no significant brand differences between year-round and seasonal chewing tobacco users, but the former were much more likely to report use of more than three pouches per week.

Table 3

Characteristics of seasonal and year-round ST users seen in years 2 and 3 and association of each characteristic with year-round use

	Year-Round		Seasonal		Univariate Analysis ^a	Multivariate Analysis ^b
	(n)	Mean	(n)	Mean	p	
Age, yr	(270)	24.1	(282)	24.1	(0.92)	(0.13)
Age at First Use, yr	(271)	16.2	(281)	17.4	(0.0001)	(0.29)
Duration of Use, yr	(266)	7.0	(275)	5.1	(< 0.0001)	(0.066)
Hours of Use/Day	(256)	2.1	(251)	0.9	(< 0.0001)	(0.0001)
Time Since Last Use, h ^c	(162)	10.5	(178)	25.8	(0.0001)	(0.096)
	(n)	Percentage	(n)	Percentage		
Race ^d					(0.009)	(0.785)
White	(235)	87.4%	(213)	77.0%		
Black	(19)	7.0	(27)	9.9		
Latino	(14)	5.2	(32)	11.4		
Other	(1)	0.4	(5)	1.8		
Type of ST Usually Used ^e					(< 0.0001)	(0.0008)
Snuff	(238)	90.0	(180)	66.4		
Chew	(22)	8.2	(82)	30.4		
Both	(5)	1.8	(9)	3.2		

^a Univariate *p* values are from two-tailed *t* tests for continuous variables (age, age at first use, duration of use, hours of use per day, and time since last use) and from χ^2 tests for categorical variables (race and type usually used).

^b Multivariate *p* values are from the multivariate logistic regression model with seasonal use as the dependent variable and all variables in the table as predictors. The multivariate analysis was confined to current-week ST users seen in year 2 (*n*=298), because information on recency of use was not available for players seen in year 3.

^c Includes only current-week ST users seen in year 2.

^d Players in the "other" category were excluded from both univariate and multivariate analyses.

^e Players who reported using both snuff and chewing tobacco were excluded from both univariate and multivariate analyses.

Finally, serum cotinine levels were significantly higher in year-round users than in seasonal users (199.2 vs. 71.4 ng/mL, respectively).

The fact that year-round users were more likely than seasonal users to use snuff suggested that it might be a more addictive product than chewing tobacco. We therefore compared snuff and chew users in terms of several surrogate measures of addiction, using the combined baseline data from all 3 yr of the study. Compared with chewing tobacco users, snuff users used ST more hours per day, had used ST more recently, had higher serum cotinine levels, and were more likely to be year-round users (Table 5).

Table 4
Additional characteristics of seasonal and year-round ST users

	Seasonal	Year-Round	p ^a
Brand ST Usually Used			
Snuff	(n=186)	(n=243)	0.0001
Copenhagen	62.9%	76.5%	
Skool	22.0	18.9	
Hawken	12.4	2.0	
Other	2.7	2.5	
Chew	(n=85)	(n=22)	0.68
Levi Garrett	51.8	45.4	
Red Man	29.4	27.3	
Other	18.8	27.3	
Amount Used			
Snuff (cans/wk)	(n=182)	(n=241)	< 0.0001
≤ 1	63.2	24.1	
1 to 3	29.7	39.0	
> 3	7.1	36.9	
Chew (pouches/wk)	(n=84)	(n=22)	0.023
≤ 1	56.0	36.4	
1 to 3	32.1	27.3	
> 3	11.9	36.4	
Serum Cotinine (ng/mL)	(n=121)	(n=95)	< 0.0001
	mean=71.4	mean=199.2	

^a Based on χ^2 test.

We found no significant differences in age, race, age at initiation, or duration of ST use between snuff and chewing tobacco users among these professional baseball players.

Finally, we examined perceptions of health effects of ST and attitudes toward quitting among current-week users, distributed by seasonality of use and type of ST used (Table 6). Year-round snuff users were more likely to report having noticed sores, white patches, or gum problems where ST is placed in the mouth (39.5 percent) than were chew users or seasonal snuff users. When asked how harmful to their health they thought ST use to be, only a small proportion indicated that they didn't know or that it was "not at all" harmful. However, both year-round and seasonal snuff users were more likely than chewing tobacco users to think that ST is "very harmful" and nearly twice as likely to indicate that they were thinking about quitting ST use in the next 12 mo. Snuff users reported more quit attempts to date than chewing tobacco users and scored somewhat higher on a quit ladder, a scale of 1 to 10 that measures readiness to quit.

Table 5
Characteristics of current snuff and chewing tobacco users

	Type of ST Usually Used		p ^a
	Snuff	Chewing Tobacco	
	Mean		
Use/Day, h	1.9	1.1	0.0004
Hours Since Last Use	14.1	29.3	< 0.0001
Serum Cotinine, ng/mL ^b	149.6	46.7	< 0.0001
Age, yr	24.1	24.6	0.29
Age at Initiation	17.1	17.0	0.80
Duration of Use, yr	6.1	6.1	0.93
	Percentage		
Year-Round Users ^c	56.6%	20.6%	
Race			
White	83.2	80.6	0.87
Black	8.3	9.0	
Latino	7.8	9.7	
Other	0.7	0.7	

^a Based on *t* test for continuous variables; χ^2 test for race.

^b Serum cotinine analysis is based on all current-week ST users seen in year 1 plus all current-week users seen for the first time in year 2.

^c Seasonal use analysis is based on all current-week ST users seen in year 2 plus all current-week users seen for the first time in year 3.

DISCUSSION This report, based on combined baseline data collected from 2,009 Major League and minor league baseball players from 1988 through 1990, confirms our earlier findings, based on the 1988 data alone (Ernster et al., 1990), of a high rate of ST use in this population (37.5 percent). Two other studies of Major League Baseball players surveyed in 1987 reported comparable results: Connolly and coworkers (1988) found that 34 percent of 265 players who completed questionnaires at spring training in Florida were self-reported current ST users, and Wisniewski and Bartolucci (1989) found that 45.6 percent of the 528 players on 25 teams who responded to a mail survey were current users. In all three studies, snuff was found to be the preferred form of ST; a snuff brand was reported as the product usually used by 77 percent of ST users in our study and 71 percent of users surveyed by Connolly and coworkers.

The prevalence of ST use found among professional baseball players is much higher than that reported for young men in the general population (5.9 percent among men aged 20 to 29 in 1986, with much regional variation) (Bauman et al., 1989; Marcus et al., 1989; Novotny et al., 1989; Rouse, 1989), and generally much higher than reported in school-based studies of adolescent males (Ary, 1989; Ary et al., 1987; Boyd et al., 1987; Brownson

Table 6
Perceptions of health effects and attitudes toward quitting among current ST users, by seasonality of use and type of ST used^a

	Seasonal Use		Year-Round Use	
	Chew	Snuff	Chew	Snuff
“How harmful do you think that chewing/dipping tobacco is for your health?”	(n=65)	(n=131)	(n=18)	(n=172)
Not at all harmful/don't know	4.6%	12.2%	5.6%	5.8%
Slightly/somewhat harmful	72.3	56.5	72.2	61.1
Very harmful	23.1	31.3	22.2	33.1
“Have you ever noticed sores, white patches, or gum problems where you hold the tobacco in your mouth?”	(n=65)	(n=131)	(n=18)	(n=172)
Affirmative responses	16.9	22.1	22.2	39.5
“Are you seriously thinking about quitting chewing/dipping tobacco in the next 12 months?”	(n=64)	(n=129)	(n=18)	(n=172)
Affirmative responses	34.4	58.1	33.3	60.2
“How many times have you seriously tried to quit?”	(n=60)	(n=111)	(n=18)	(n=157)
	0.4	1.7	1.1	1.7
Score on quitting ladder ^b	(n=47)	(n=93)	(n=10)	(n=142)
	4.7	5.8	4.0	5.7

^a Results are based on all current-week users seen in year 2, with the exception of “score on quitting ladder,” which is based on all current-week smokeless tobacco users seen in year 3.

^b Measures readiness to quit using smokeless tobacco; values range from 0 (“no thought of quitting”) to 10 (“taking action to quit”).

et al., 1990; Colburn et al., 1989; Creath et al., 1988; Glover et al., 1986; Jones and Moberg, 1988; Kegeles et al., 1989; Leopardi et al., 1989; Murray et al., 1988). Only Native Americans have comparably high rates in the United States (Bruerd, 1990; Hall and Dexter, 1988; Schinke et al., 1989). However, it appears that about one-half of users in our study who reported use within the past week were seasonal users, which means that the prevalence of year-round use may be closer to 18 or 19 percent in this group. On the one hand, the ability to “take or leave” ST during the off-season might be seen as an indication that many individuals can use ST without becoming addicted. On the other hand, year-round users differ from seasonal users in ways that suggest ST is an addictive product for many individuals. Year-round users use ST more hours per day, use more cans of snuff or pouches of chew, have used ST more recently, and have higher serum cotinine levels than seasonal users.

Year-round users in our study were also more likely to usually use snuff than were seasonal users, which suggests that snuff may be more addictive than chewing tobacco. When we compared current ST users who usually

used snuff to those who usually used chewing tobacco, our findings were similar to those reported in the comparison of year-round to seasonal users. Snuff users used ST more hours per day than chewing tobacco users, had used ST more recently, and had higher serum cotinine levels. Not surprisingly, they were also more likely to be year-round users. Among snuff users, those who used ST year-round were more likely to use the Copenhagen brand and less likely to use the Hawken brand than seasonal users. Thus, snuff users, particularly users of the most popular brands, seem much less able to restrict their ST use to the baseball season than chewing tobacco users. These findings are interesting in light of our earlier report of a much higher risk of leukoplakia in snuff users than in chewing tobacco users, and the lower risk of leukoplakia in users of Hawken than in users of other snuff brands (Grady et al., 1990).

Finally, snuff users seem to have a greater awareness of the health hazards of ST use and to be more motivated to quit than chewing tobacco users. Snuff users were more likely to think their ST use might be "very" harmful to their health, were much more likely to indicate that they were seriously thinking about quitting in the next 12 mo, and had higher scores on readiness to quit. Compared with chewing tobacco users and seasonal snuff users, year-round snuff users were also more likely to report having noticed sores, white patches, or gum problems where they held tobacco in the mouth. Given their own subjective experience, and our earlier findings of a much greater risk of oral lesions for snuff users, the perception of greater adverse health risks on the part of snuff users than of chewing tobacco users may be well founded.

Our findings underscore the importance, for future studies, of distinguishing between snuff and chewing tobacco users and, where applicable, between year-round and seasonal ST users. If only because intensity of use appears to differ markedly by ST type and seasonal use, separate analyses should be performed to distinguish health risks associated with these different types of use.

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